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IS 3114 (1994): Code of practice for laying of cast iron pipes [CED 24: Public Health Engineering.]

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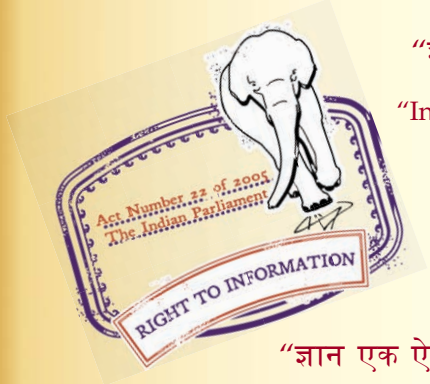

"ज्ञान एक ऐसा खजाना है जो कभी चुराया नहीं जा सकता है"
Bhartṛhari—Nītiśatakam
"Knowledge is such a treasure which cannot be stolen"

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IS 3114 : 1994
(Reaffirmed 2004)

भारतीय मानक

ढलवाँ लोहे के पाइप डालने की रीति संहिता

(दूसरा पुनरीक्षण)

Indian Standard

CODE OF PRACTICE FOR LAYING OF CAST IRON PIPES

(Second Revision)

First Reprint APRIL 1999

UDC 628.247.13 : 621.643.2 [669.13] : 006.76

BUREAU OF INDIAN STANDARDS
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NEW DELHI 110 002

December 1994

Price Group 6

FOREWORD

This Indian Standard (Second Revision) was adopted by the Bureau of Indian Standards, after the draft finalized by the Water Supply and Sanitation Sectional Committee had been approved by the Civil Engineering Division Council.

Laying of cast iron pipes for water supply and drainage purposes has been generally governed by the regulations laid down by the various municipalities and municipal corporations. These regulations are intended to ensure proper laying of pipes giving due consideration to economy and safety of workers engaged in pipe laying. This standard was first published in 1965 and subsequently revised in 1985 to ensure fulfilment of minimum requirement for proper and safe laying of cast iron pipes. The present revision incorporates the method of laying the rubber ring joints and makes reference to the latest Indian Standards for various types of materials specified herein.

In the formulation of this standard due weightage has been given to international coordination among the standard practices prevailing in different countries in addition to relating it to the practices in this field in this country. This has been met by deriving assistance from the following publications:

ANSI/AWWA/C : 600 : 1987 Installation of ductile iron water mains and their apparatus. American National Standards Institute.

Catalogue of Indian Iron and Steel Company, Calcutta.

For the purpose of deciding whether a particular requirement of this standard is complied with, the final value, observed or calculated, expressing the result of a test or analysis, shall be rounded off in accordance with IS 2 : 1960 'Rules for rounding off numerical values (*revised*)'. The number of significant places retained in the rounded off value should be the same as that of the specified value in this standard.

This code of practice represents a standard of good practice and therefore takes the form of recommendation.

The committee responsible for the preparation of this standard is given in Annex B.

Indian Standard

CODE OF PRACTICE FOR LAYING OF CAST IRON PIPES

(Second Revision)

1 SCOPE

1.1 This code covers the methods of laying cast iron pipes below ground level for water supply and drainage purposes. It also includes handling and jointing of pipes, hydrostatic tests, backfilling, restoration and maintenance of surfaces.

1.2 For the purposes of this code, cast iron pipes shall conform to IS 1536 : 1989 and IS 1537 : 1976 and cast iron fittings to IS 1538 (Part 1) : 1976.

1.3 This code does not cover installations that require special attention, techniques and materials like:

a) Piping through rigid walls,
b) Subaqueous piping,
c) Piping requiring insulation, and
d) Plant or pump station piping.

2 REFERENCES

The Indian Standards listed in Annex A are necessary adjuncts to this standard.

3 EXCAVATION AND PREPARATION OF TRENCH

3.1 General

The trench shall be so dug that the pipe may be laid to the required alignment and at the required depth. When the pipeline is under a roadway, a minimum cover of 1.0 m is recommended for adoption, but it may be modified to suit local conditions by taking necessary precautions. The trench shall be excavated only so far in advance of pipe laying as specified by the Authority. The trench shall be so braced and drained that the workmen may work therein safely and efficiently. The discharge of the trench dewatering pumps shall be conveyed either to drainage channels or to natural drains and shall not be allowed to be spread in the vicinity of the work site.

NOTE — For the purpose of this code, Authority may be an individual, an official, a board, a department or an agency established and authorized by union or State Government or any Statutory body created by law who undertakes to administer and enforce the provision of this code as adopted or amended.

3.1.1 *Trenching by Machine or by Hand*

Hand methods for excavation shall be employed in locations shown on the drawings given by the Authority. In other places excavation may be done by hand or by machine.

3.2 Width of Trench

The width of the trench at bottom between faces of sheeting shall be such as to provide not less than 200 mm clearance on either side of the pipe except where rock excavation is involved. Trenches shall be of such extra width, when required as will permit the convenient placing of timber supports, strutting and planking, and handling of specials.

3.3 Provisions for Joints

Additional width shall be provided at positions of sockets and flanges for jointing to be made properly. Depths of pits at such places shall also be sufficient to permit finishing of joints.

3.4 Pipe Clearance in Rocks

Ledge rock, boulders and large stones shall be removed to provide a clearance of at least 150 mm below and on each side of pipes, valves and fittings for pipes 600 mm in diameter or less, and 200 mm for pipes larger than 600 mm in diameter.

3.4.1 The specified minimum clearances are the minimum clear distances which will be permitted between any part of the pipe or appurtenance being laid and any part, projection or point of such rock, boulder or stone.

3.5 Limits of Excavation Relative to Gradients

Except where special foundations are to be provided for the reasons given in 3.8, the trench shall be excavated in accordance with one of the following alternatives as may be considerred appropriate by the Authority:

a) The trench shall be excavated to the exact gradient specified so that no making of the sub-grade by backfilling is required and the pipe rests on solid and undisturbed ground when laid;

b) When the bottom of the trench at the specified gradient is found to be unstable or to include ashes and cinders, all types of refuse, vegetable or other organic material, or large pieces or fragments of inorganic material, they shall be removed to the satisfaction of the Authority; and

c) Where the excavation is in rock or boulders, the clearance specified in 3.4 shall be provided.

3.6 Trimming of Trench Bottoms

Where rock and large stone or boulders are encountered, the trench shall be trimmed to a depth of at least 150 mm below the level at which the bottom of the barrel of the pipe is to be laid, and filled to a like depth with granular material to pass through a sieve of 12.5 mm aperture size [*see* IS 2405 (Part 2) : 1980] and well rammed to form a fair and clean bed for pipe.

3.7 Finish of Surfaces

In all cases there shall be a uniform and continuous bearing and support for the pipe at every point between the sockets or flanges except that it will be permissible to disturb and otherwise damage the finished surface over a maximum length of 450 mm near the middle of each pipe length by the withdrawal of pipe slings or other lifting tackle. The finished sub-grade shall be prepared accurately by means of hand tools.

The sub-grade beneath the centreline of the pipe shall be finished to within one cm of a straight line between the pipe joints or batten boards.

3.8 Special Foundation in Poor Soil

Where the bottom of the trench and sub-grade is found to consist of material which is unstable to such a degree that, in the opinion of the Authority, it cannot be removed and replaced with an approved material thoroughly compacted in place to support the pipe properly, a suitable foundation for the pipe, consisting of piling, timbers or other materials, in accordance with plans prepared by the Authority shall be constructed.

3.8.1 *Previous Excavations*

Where the trench passes over a sewer or other previous excavation, the trench bottom shall be sufficiently compacted to provide support equal to that of the native soil or conform to other regulatory requirements in a manner that will prevent damage to the existing installation.

3.9 Rock Excavation

The term 'rock' wherever used in this standard shall have the same meaning as given under terminology in IS 1200 (Part 1) : 1974.

3.10 Blasting

Blasting for excavation shall be permitted only after securing the approval of the Authority and only when proper precautions are taken for the protection of persons or property. The hours of blasting shall be fixed by the Authority. The procedure of blasting shall conform to the requirements of local controlling Authority.

3.11 Braced and Sheeted Trenches

Open-cut trenches shall be sheeted and braced as required by any governing state laws and municipal regulations and as may be necessary to protect life, property or the work. When close sheeting is required, it shall be so driven so as to prevent adjacent soil from entering the trench either below or through such sheeting.

3.11.1 The Authority shall have the right to order the sheeting to be driven to the full depth of the trench or to such additional depths as may be required for the protection of the work. Where the soil in the lower limits of a trench has the necessary stability, the Authority at discretion, may permit stopping of the driving of sheeting at some designated elevation above the trench bottom.

3.11.2 Sheeting and bracing which have been ordered to be left in place should be removed for a distance of 900 mm below the established street level or the existing surface of the street, whichever is lower. Trench bracing, except that which should be left in place, may be removed when the back filling has reached the respective levels of such bracing. Sheeting, except that which has been left in place, may be removed after the backfilling has been completed or has been brought up to such an elevation as to permit its safe removal. Sheeting and bracing may be removed before filling the trench, but only in such manner as will ensure the adequate protection of the completed work and adjacent structures.

3.12 Care of Surface Material for Re-use

All surface materials which in the opinion of the Authority, are suitable for re-use in restoring the surface shall be kept separate from the general excavation material as directed by the Authority.

3.13 Stacking Excavated Material

All excavated material shall be stacked in such a manner that it will not endanger the work or workman and it will avoid obstructing footpaths and roads driveways. Hydrants under pressure, surface boxes, fire of other utility controls shall be left unobstructed and accessible until the work is completed. Gutters shall be kept clear or other

satisfactory provisions made for street drainage, and natural water-courses shall not be obstructed.

3.14 Barricades, Guards and Safety Provisions

To protect persons from injury and to avoid damage to property, adequate barricades, construction signs, torches, red lanterns and guards as required shall be placed and maintained during the progress of the construction work, and until it is safe for traffic to use the roadways. All materials pipes, equipment and pipe which may serve as obstructions to traffic shall be enclosed by fences or barricades and shall be protected by proper lights when the visibility is poor. The rules and regulations of the local authorities regarding safety provisions shall be observed.

3.15 Maintenance of Traffic and Closing of Streets

The work shall be carried in such a manner which will cause the least interruption to traffic, and the road/street may be closed in such a manner that it causes the least interruption to the traffic. Where it is necessary for traffic to cross open trenches, suitable bridges shall be provided.

3.15.1 Suitable signs indicating that a street is closed shall be placed and necessary detour signs for the proper maintenance of traffic shall be provided.

3.16 Structurre Protection

Temporary support, adequate protection and maintenance of all underground and surface structures, drains sewers and other obstructions encountered in the progress of the work shall be furnished under the direction of the Authority. The structure which may have been disturbed shall be restored upon completion of the work.

3.17 Protection of Property and Surface Structures

Trees, shrubbery fences, poles and all other property and surface structures shall be protected unless their removal is shown on the drawings or authorrized by the Authority. When it is necessary to cut roots and tree branches, such cutting shall be done under the supervision and direction of the Authority.

3.18 Interruption of Service

No valve or other control of the existing services shall be operated without the permission of the Authority.

4 LAYING

4.1 Unloading of Pipes

While unloading, pipes shall not be thrown down from the trucks on hard roads. Unloading them on timber skids without a steadying rope and thus allowing the pipes to bump hard against one another should not be allowed. In order to avoid damage to the pipes and specially to the spigot end, pipe should not be dragged along concrete and similar pavements with hard surfaces.

4.2 Detection of Cracks in Pipes

The pipe and fittings shall be inspected for defects and be rung with a light hammer preferably while suspended to detect cracks. Smearing the outside with chalk dust helps the location of cracks. If doubt persists further confirmation may be obtained by pouring a little kerosene on the inside of the pipe at the suspected spot; if a crack is present the kerosene seeps through and shows on the outer surface.

4.2.1 If a pipe is mishandled either accidentally or due to carelessness during unloading or lowering it should be thoroughly inspected before laying and shall be rejected if found unsuitable by the Authority.

4.3 Lowering of Pipes and Fittings

Proper implements, tools and facilities satisfactory to the Authority shall be provided and used for the safe and convenient execution of the work. All pipes, fittings, valves and hydrants shall be carefully lowered into the trench, piece by piece, by means of a derrick, ropes or other suitable tools or equipment, in such a manner as to prevent damage to pipes materials and protective coatings and linings. Under no circumstances shall pipes materials be dropped or dumped into the trenches. Pipes over 300 mm diameter shall be handled and lowered into trenches with the help of chain pulley blocks. Tripod supports used for this purpose shall be regularly checked to prevent all risks of accidents.

4.4 Cleaning of Pipes and Fittings

All lumps, blisters and excess coating material shall be removed from the socket and spigot end of each pipe and the outside of the spigot and the inside of the socket shall be wire-brushed and wiped clean and dry and free from oil and grease before the pipe is laid.

4.5 Laying Pipe

Every precaution shall be taken to prevent foreign material from entering the pipe while it is being placed in the line. If the pipelaying team cannot put the pipe into the trench and in place without getting earth into it, the Authority may require that before lowering the pipe into the trench, a heavy, tightly woven canvas bag of suitable size shall be placed over each end and left there until the connection is to be made to the adjacent pipe. During laying

operations, no debris, tools clothing or other materials shall be placed in the pipe.

4.5.1 At times when pipe laying is not in progress, the open ends of pipe shall be closed by a watertight plug or other means approved by the Authority.

4.5.2 Joints of pipe in the trench which cannot be poured shall be caulked with jointing materials to make them watertight. Alternatively, flanged pipe/threaded pipe may be used.

4.6 Number of Pipes Laid Before Jointing

Wherever the jointing material specified is cement, six or more lengths of pipe shall be laid in place ahead of each joint before such a joint is finished.

4.7 Cutting of Pipe

The cutting of pipe for inserting valves, fittings or closure pieces shall be done in a neat and workmanlike manner without damage to the pipe or cement lining so as to leave a smooth end at right angles to the axis of the pipe. For this purpose use of a pipe cutting machine is recommended.

4.7.1 When pipe cutting machine is not available for cutting pipes of large diameters, the electric-arc cutting method may be permitted using a carbon or steel rod. Only qualified and experienced workmen shall be employed on this work.

4.7.2 When the pipe cutting machine is not available and the site conditions do not permit pipe cutting by machines, the pipe can be cut using chisels.

4.7.3 The flame cutting of pipe by means of an oxyacetylene torch shall not be allowed.

4.8 Direction of Laying of Socket End

On level ground, the socket ends should face the upstream. When the line runs uphill the socket ends should face the upgrade.

4.9 Permissible Deflection at Socket and Spigot Joints

Where necessary to deflect pipe from a straight line, either in the vertical or horizontal plane, to avoid obstructions or where long radius curves are permitted, deflection at joint shall not exceed the following:

Lead joints	$2\frac{1}{2}^\circ$
Rubber joints	
For nominal bore 80 to 300 mm	5°
For nominal bore 350 to 400 mm	4°
For nominal bore 450 to 750 mm	3°

4.10 Pipelines Crossing Railway Line

The Authority should consult the railways before preparing plans and specifications for this part of the work.

4.10.1 Where the pipes run beneath tram tracks or are located in areas where similar vibratory effects are likely, care should be taken to avoid any direct transmission of the vibrations to the pipes itself. Adequate cover with soft well-packed filling is essential.

4.11 Conditions Unsuitable for Laying of Pipe

No pipe shall be laid in or when, in the opinion of the Authority, trench conditions are unsuitable.

4.12 Casing Pipes

When the pipes run beneath the heavy loads, suitable size of casing pipes/culverts may be provided to protect the carrier pipe or when required by the Authority.

4.13 Clearance

When crossing existing pipelines or other structures, alignment and grade shall be adjusted as necessary, with the approval of the Authority to provide clearance as required by state or local regulations or as deemed necessary by Authority to prevent future damage or contamination of either structure.

5 USAGE OF ANCHOR AND THRUST BLOCKS IN PIPELINES

5.1 General

High pressure mains need anchorages at dead ends and bends, as appreciable thrust occur which tend to cause 'draw' and even blow out of joints. Where the thrust is appreciable, concrete blocks should be installed at all points where movement may occur.

5.2 Hydrants

The bowl of each hydrants shall be well braced against a sufficient area of unexcavated earth at the end of the trench with stone slab or concrete backing, or it shall be tied to the pipe with suitable metal tie rods, clamps, or restrained joints as shown or directed by the Authority.

5.2.1 Tie rods, clamps or other components of dissimilar metal shall be protected against corrosion by hand application of a bituminous coating.

5.3 Pipelines

Anchorages are necessary to resist the tendency of the pipes to pull apart:

a) at bends or other points of unbalanced pressure, or

b) when they are laid on step gradients and the resistance of their joints to longitudinal (shearing) stresses is either exceeded or inadequate. They are also used to restrain or direct the expansion and contraction of rigidly joined pipes under the influence of temperature changes.

5.3.1 It is advisable to avoid sharp bends above 45° and in soft ground it is better not to put two bends together but to separate them by at least a length of straight pipe. If the pressures are high enough to merit it and sleeve joints are being used, the joints on the bends and on two pipes either side of them should be fully welded inside and outside, and the trench, refilled with concrete to 150 mm above these pipes and bends. Pipes laid on steep inclines should be anchored or transversed blocks or other precautions taken to prevent slippage and measures to overcome unbalanced pressures provided.

5.4 Anchor or thrust blocks shall be designed in accordance with IS 5330 : 1984. Thrust resistant design pressure should be equal to the test pressure.

5.5 Restrain Materials

Vertical and horizontal reaction backing shall be made of concrete of grade M15 conforming to IS 456 : 1978.

6 JOINTING OF PIPES

6.1 Jointing of Socket and Spigot Pipes

Jointing may be done with any of the following materials:

a) Molten lead (under dry conditions),
b) Lead wool (under wet conditions),
c) Cement, and
d) Tarred yarn (for sewers only where considered necessary).

6.1.1 *Yarning or Packing Material*

Yarning or packing material shall consist of one of the following:

a) Spun yarn,
b) Moulded or tubular natural or synthetic rubber rings,
c) Asbestos rope, or
d) Treated paper rope.

NOTE — In sewerage system the usage of natural or synthetic rubber rings may be decided by the Authority taking into consideration the characteristics of effluent.

6.1.1.1 All the materials mentioned in **6.1.1** shall be handled with care in order to prevent contamination and shall be dry when put into place in the joint. The material used shall be free of oil, tar or greasy substances. In cement joints, the yarning materials may be omitted if so specified.

NOTE — Spun yarn used as a jointing material shall be of sterilized quality. It shall have been exposed to vapours of 40 percent formaldehyde in air-tight chamber for three hours before using it in water main.

6.1.2 *Placing of Yarning Material*

The yarning material shall be placed around the spigot of the pipe and shall be of proper dimensions to centre the spigot in the socket. When the spigot is shoved home, the yarning material shall be driven tightly against the inside base or hub of the socket with suitable yarning tools.

6.1.2.1 When a single strand of yarning material is used, it shall have an overlap at the top of not more than 50 mm. When more than a single strand is required for a joint, each strand shall be cut to sufficient length so that the ends will meet without causing overlap. The ends of the strands shall meet on opposite sides of the pipe and not on the top or at the bottom. Successive strands of yarning material shall be driven home separately.

6.1.3 *Lead Joints*

6.1.3.1 Lead for caulking purposes should conform to IS 782 : 1978.

6.1.3.2 *Quantity of lead for joints*

The quantity of lead required for different sizes of pipes are given in Table 1.

6.1.3.3 *Heating and pouring of lead*

Lead shall be heated in a melting pot kept in easy reach of the joint to be poured so that the molten metal will not be chilled in being carried from the melting pot to the joint and shall be brought to a proper temperature so that when stirred it will show a rapid change of colour. Before pouring, all scum shall be removed. Each joint shall be made with one continuous pour filling of the entire joint space with solid lead. Spongy or imperfectly filled joints shall be burnt/chiselled out and repoured.

6.1.3.4 *Position of joint runner*

The joint runner shall fit snugly against the face of the socket and the outside of the pipe shall be dammed with clay to form a pouring lip to provide for filling the joint flush with the face and to the top of the socket.

6.1.3.5 *Procedure for caulking of socket and spigot joints*

The common form of joint is made by first caulking in spun yarn then filling the remainder of the joint space by running in molten lead, taking care that no

dross enters the joint, and then thoroughly caulking the lead. The lead need not extend into the joint further than the back of the groove formed in the socket.

Table 1 Quantity of Lead for Different Sizes of Pipes
(Clause 6.1.3.2)

Nominal Size of Pipe mm (1)	Lead/Joint kg (2)	Depth of Lead Joint mm (3)
80	1.8	45
100	2.2	45
125	2.6	45
150	3.4	50
200	5.0	50
250	6.1	50
300	7.2	55
350	8.4	55
400	9.5	55
450	14.0	55
500	15.0	60
600	19.0	60
700	22.0	60
750	25.0	60
800	31.5	65
900	35.0	65
1 000	41.0	65
1 100	46.0	65
1 200	52.0	70
1 500	66.5	75

NOTE — The quantities of lead given are provisional and a variation of 20 percent is permissible either way.

The spun yarn is used to centre the spigot in the socket, to prevent the flow of molten lead into the bore of the pipe, to reduce the amount of lead required to complete the joint and to make the joint watertight. Spun yarn may become infected with bacteria, which may contaminate the water and, therefore, shall be effectively disinfected before use (*see* Note under **6.1.1.1**).

Alternatively, proprietary brands of sterilized spun yarn may be used. Shreded lead or lead wire or strip may be used instead of spun yarn, thus producing a solid lead joint. Lead covered yarn may also be used which does not have the disadvantages of plain yarn. Cold lead may be caulked into the joint space first followed by spun yarn, and the joint then completed with cold or molten lead.

Caulking may be done with pneumatic tools or with a hand hammer weighing not less than 2 kg. When working with lead wool, it is very important to use caulking tools of appropriate thickness to fill the joint space, and to thoroughly consolidate the material from the back to the front of the socket. Lead run joints shall be preferably finished 3 mm behind the socket face.

6.1.3.6 *Quantity of lead wool and spun yarn for joints*

The quantity of lead wool and spun yarn required for different sizes of pipes are given in Table 2. As lead wool jointing is mostly done in difficult site conditions, higher tolerances may be permitted in practice from the quantities specified in Table 2.

6.1.4 *Cement Joints*

6.1.4.1 Where cement joints are used for cast iron gravity sewers, cement as permitted in IS 456 : 1978 may be used.

6.1.4.2 *Procedure*

Closely twisted spun yarn gasket of such diameter as required to support the spigot of the pipe at the proper grade and make truly concentric joints, and in one piece of sufficient length to pass around the pipe and lap at the top, shall be thoroughly saturated in cement paste. This gasket shall be laid in the socket for the lower third of the circumstances of the joint and covered with cement mortar (1 cement: 1 coarse sand). The spigot of the pipe shall be thoroughly cleaned with a wet brush, inserted and carefully driven home, after which a small amount of mortar shall be inserted in the annular space around the entire circumference of the pipe and solidly rammed into the joint with a caulking tool, the mortar previously placed being driven ahead of the gasket. The remainder of the joint shall then be completely filled with mortar and bevelled off at an angle of 45 degrees with the outside of the pipe. On pipes of 450 mm in diameter or larger, the joints shall be pointed and smoothed from the inside. While making cement joints, one lead joint shall be introduced for every ten cement joint.

The inside of the pipe shall be cleaned after the mortar sets slightly by dragging a large gunny-wrapped block of wood or straw through the pipe. Care is, however, necessary to see that this block is not left in the sewer when the work is interrupted or completed.

6.1.4.3 *Time interval before filling pipe*

Pipe laid with cement joints shall not be filled with water until a lapse of twelve hours after the last joint in any valved section has been made, and pressure shall not be permitted in the pipe until all joints have aged as provided in **7.4.**

6.1.5 *Rubber Ring Joints*

6.1.5.1 In the case of rubber ring joints or push on joints, the groove and the socket shall be thoroughly cleaned before inserting the rubber gasket. While inserting the gasket it shall be made sure that it

faces the proper direction and that it is correctly seated in the groove. After cleaning dirt or foreign materials from the plain end, lubricant shall be applied in accordance with the pipe manufacturer's recommendations.

Table 2 Quantities of Lead Wool and Spun Yarn for Different Sizes of Pipes
(*Clause* 6.1.3.6)

(Materials for Single Collar Joints)

Nominal Internal Dia in mm (1)	Lead Wool Mass in kg (2)	Spun Yarn Mass in kg (3)
80	1.30	0.17
100	1.70	0.23
150	2.41	0.34
175	2.89	0.37
200	3.37	0.57
225	3.63	0.64
250	4.11	0.74
300	4.82	0.82
350	6.04	1.17
375	6.52	1.25
400	7.00	1.33
450	9.64	1.84
500	10.86	1.99
600	12.79	2.83
750	15.68	3.52
825	17.12	3.88
900	18.80	4.25
1 200	28.44	6.01

NOTE — Under special circumstances the Engineer-in-Charge may decide the quantities of lead wool/spun yarn depending upon the site conditions.

6.1.5.2 The contractor shall make sure that the plain end is bevelled as square or sharp edges may damage or dislodge the gasket and cause a leak. When the pipe is cut at site, the plain end shall be bevelled with a heavy file or grinder to remove all sharp edges.

6.1.5.3 The plain end of the pipe shall be pushed into the socket of the pipe and while pushing, the pipe shall be kept straight. If any deflections are to be made in the alignment, it may be made after the joint is assembled. A timber header shall be used between the pipe and crowbar or jack to avoid damage to the pipe while the plain end of the pipe is pushed into the socket either with a crow bar or jack, or lever puller.

6.2 Flanged Joints

Cast iron pipes may also be jointed by means of flanges.

6.2.1 The gaskets used between flanges of pipes shall be compressed fibre board or natural/synthetic rubber (*see* IS 638 : 1979) of thickness between 1.5 to 3 mm. The fibre board shall be impregnated with chemically neutral mineral oil and shall have a smooth and hard surface. Its weight per square metre shall be not less than 112 g/mm thickness.

6.2.2 Each bolt should be tightened a little at a time taking care to tighten diametrically opposite bolts alternatively. The practice of fully tightening the bolts one after another is highly undesirable.

6.2.3 Several proprietary flexible joints are available for jointing cast iron pipes and these may be used with the specific approval of the Authority; however, they shall be used strictly in accordance with the manufacturer's instructions.

7 HYDROSTATIC TESTS

7.1 Types of Tests

After a new pipe has been laid, jointed and backfilled in accordance with **7.4.2**, it (or any valved section thereof) shall be subjected to the following two tests:

a) Pressure test at a pressure as specified in **7.2**, and

b) Leakage test at a pressure to be specified by the Authority for a duration of two hours.

7.2 Procedure for Pressure Test

7.2.1 *Pressure Test*

The field test pressure to be imposed shall be not less than the greatest of the following:

a) One and a half times the maximum sustained operating pressure,

b) One and a half times the maximum pipeline static pressure, and

c) Sum of the maximum static pressure and surge pressure subject to the works test pressure.

Where the field test pressure is less than two-thirds the works test pressure, the period of test should be increased to at least 24 hours. The test pressure shall be gradually raised at the rate of nearly 0.1 N/mm^2 per minute.

If the pressure measurements are not made at the lowest point of the section, an allowance should be made for the static head between the lowest point, and the point of measurement to ensure, that the maximum pressure is not exceeded at the lowest point. If a drop in pressurre occurs, the quantity of water added in order to re-establish the test pressure should be carefully measured. This should not exceed 0.1 litre per mm of pipe dia per km of pipeline per day for each 30 metres head of pressure applied.

7.2.2 *Pressurization*

Each valved section of pipe shall be filled with water slowly and the specified test pressure, based on the elevation of lowest point of the linear section under test and corrected to the elevation of the test gauge, shall be applied by means of a pump connected to the pipe in a manner satisfactory to the Authority.

7.2.3 *Examination Under Pressure*

All exposed pipes, fittings, valves hydrants and joints should be carefully examined during the open-trench test. When the joints are made with lead, all such joints showing visible leaks shall be recaulked until tight. When the joints are made with cement and show seepage or slight leakage, such joints shall be cut out and replaced as directed by the Authority. Any cracked or defective pipes, fittings, valves or hydrants discovered in consequence of this pressure test shall be removed and replaced by sound material and the test shall be repeated until accepted by the Authority.

7.3 Procedure for Leakage Test

7.3.1 A leakage test shall be conducted concurrently with the pressure test. Leakage is defined as the quantity of water to be supplied into the newly laid pipe, or any valved section thereof within 0.035 N/mm^2 of the specified leakage test pressure after the air in the pipeline has been expelled and the pipe has been filled with water.

7.3.2 No pipe installation shall be accepted until the leakage is less than the number of cm^3/h as determined by the formula:

$$qL = \frac{ND\sqrt{P}}{3.3}$$

where

qL = the allowable leakage in cm^3/h,

N = number of joints in the length of the pipeline,

D = diameter in mm, and

P = the average test pressure during the leakage test in kgf/cm^2.

7.3.3 *Variation from Permissible Leaking*

Where any test of pipe laid indicates leakage greater than that specified in 7.3.2, the defective joints shall be repaired until the leakage is within the specified allowances.

7.4 Pre-requisite to Test

7.4.1 Where any section of a main is provided with concrete thrust blocks or anchorages in accordance with 5.1 and 5.2, the pressure test shall not be made until at least five days have elapsed after the concrete was cast. If rapid hardening cement has been used in these blocks or anchorages, the test shall not be made until at least two days have elapsed.

7.4.2 *Back-Filling*

Before testing, the trench may be partially back-filled, if required by site condition, except at the joints in accordance with 8. Such back-filling shall be done after obtaining the permission from the Authority.

7.4.3 *Time for Testing of Lead Jointed Pipe*

If the requirements of 7.4.1 have been complied with, a lead jointed pipe may be subjected to hydrostatic pressure, inspected and tested for leakage at any convenient time after the trench has been back-filled in accordance with 7.4.2.

7.4.4 *Time for Testing of Cement Jointed Pipe*

After the requirements of 7.4.1 have been complied with and the trench back-filled in accordance with 7.4.2, the main shall be filled with water in the manner specified in 6.1.4.3 and 7.2.1, and shall not be subjected to hydrostatic pressure inspected and tested for leakage till at least 36 hours have elapsed thereafter. The pipe shall remain full of water until all tests have been made.

7.5 In case where there are no valves, or valved sections are too long, the testing may be permitted to be carried out in suitable segments with the permission of the Authority.

8 BACK-FILLING

8.1 For the purpose of back-filling, the depth of the trench shall be considered as divided into the following three zones from the bottom of the trench to its top:

Zone A : From the bottom of the trench to the level of the centre line of the pipe,

Zone B : From the level of the centre line of the pipe to a level 300 mm above the top of the pipe, and

Zone C : From a level 300 mm above the top of the pipe to the top of the trench.

8.2 Back-Fill Material

All back-fill material shall be free from cinders, ashes, slag, refuse, rubbish, vegetable or organic material, lumpy or frozen material, boulders, rocks or stone or other material which in the opinion of the Authority, is unsuitable or deleterious. However, material containing stones up to 200 mm as their greatest dimension may be used in Zone C unless specified otherwise herein.

8.2.1 *Back-Fill Sand*

Sand used for back-fill shall be a natural sand complying with 8.2, graded from fine to coarse. The

total mass of loam and clay in it shall not exceed 10 percent. All material shall pass through a sieve of aperture size 20 mm [*see* IS 2405 (Part 2) : 1980] and not more than 5 percent shall remain on IS Sieve of aperture size 6.30 mm.

8.2.2 *Back-Fill Gravel*

Gravel used for back-fill shall be natural gravel, complying with 8.2 and having durable particles graded from fine to coarse in a reasonably uniform combination with no boulders or stones larger than 50 mm in size. It shall not contain excessive amount of loam and clay and not more than 15 percent shall remain on a sieve of aperture size 75 micron.

8.3 Back-Filling in Freezing Weather

Back-filling shall not be done in freezing weather except by permission of the Authority, and it shall not be made with frozen material. No fill shall be made where the material already in the trench is frozen.

8.4 Back-filling in Zone A shall be done by hand with sand, fine gravel or other approved material placed in layers of 150 mm and compacted by tamping. The back-filling material shall be deposited in the trench for its full width of each side of the pipe, fittings and appurtenances simultaneously.

8.5 Back-filling in Zone B shall be done by hand or approved mechanical methods in layers of 150 mm, special care being taken to avoid injuring or moving the pipe. The type of back-fill material to be used and the method of placing and consolidating shall be prescribed by the Authority to suit individual locations.

8.6 Back-filling in Zone C shall be done by hand or approved mechanical, methods. The types of back-fill material and method of filling shall be as prescribed by the Authority.

8.7 Back-Fill Under Permanent Pavement

Where the excavation is made through permanent pavements, curbs, paved footpaths, or where such structures are undercut by the excavation, the entire back-fill to the subgrade of the stuctures shall be made with sand in accordance with 8.2.1. Paved footpaths and pavements consisting of broken stone, gravel, slag or cinders shall not be considered as being of a permanent construction. Method or place and consolidating the back-fill material shall be prescribed by the Authority.

8.8 Back-Fill with Excavated Material

The excavated material may be used for back-fill in the following cases, provided it complied with 8.2:

a) In Zone C, in cases where settlement is unimportant and when shown on the drawings or specified, the back-fill shall be neatly rounded over the trench to a sufficient height to allow for settlement to the required level.

b) In any zone when the type of back-fill material is not indicated or specified provided that such material consists of loam, clay, sand, fine gravel or other materials which are suitable for back-filling in the opinion of the Authority.

8.9 Concrete Slabs Over Pipes

When pipes are laid under roads and pavements subjected to heavy traffic loads, the trenches may be covered with reinforced concrete slabs of suitable dimensions.

9 FLUSHING AND DISINFECTION OF MAINS BEFORE COMMISSIONING

9.1 The mains intended for potable water supplies should be disinfected before commissioning them for use.

9.1.1 *Disinfection of New Mains*

Special care should be taken to ensure disinfection of new mains. Among possible sources of contamination are sewer drainage, contaminated soil in the trench, contamination from workmen and or their equipment and of course unavoidable foreign material present in the trench during construction.

9.1.2 Education of crew members as to need for avoiding contamination of the main during construction is fundamental. Contractors and workmen should be thoroughly familiar with all pertinent state and local requirements governing installations of mains. All sewers, water mains and other underground conduits should be located prior to construction and relocated, if necessary, to prevent contamination during construction. Pipe should be strung on high ground. At all times when construction is not actually in progress, watertight plugs should be installed in all pipe openings. Gunny sacks and rags are not adequate. Provision should be made to pump any other water that might collect in the trench. Special care should be taken to avoid contamination of valves, fittings, and pipe interiors, both before and during construction, each should be inspected and, if necessary cleaned before installation.

After pressure testing the main, it should be flushed with water of sufficient velocity to remove all dirt and other foreign materials. When this process has been completed, disinfection (using liquid

chlorine, sodium or calcium hypochlorite) can proceed by one of the recommended methods as described in 9.2 and 9.3.

9.2 Continuous Feed

In this method, water from the distribution system or other approved source and the chlorine from selected are fed at constant rate into the new main at a concentration of at least 20 to 50 mg/litre. A properly adjusted hypochlorite solution injected into the main with a hydrochlorinator, or liquid chlorine injected into the main through a solution feed chlorinator and booster pump may be used. The chlorine residual should be checked at intervals to insure that the proper level is maintained. Chlorine application should continue until the entire main is filled. The water should remain in the main for a minimum of 24 hours, during which time all valves, hydrants, etc, along the main should be operated to ensure their proper disinfection. Following the 24 hours period no less than 10 mg/l chlorine residual should remain in the main.

9.3 Slug Method

In this method a continuous flow of water is fed with a constant dose of chlorine (as in the previous method) but with rates proportioned to give a chlorine concentration of at least 300 mg/l. The chlorine is applied continuously for a period of time to provide a column of chlorinated water that will contact all interior surfaces of the main for a period of at least three hours. As the slug passes tees, crosses, etc, proper valves must be operated to ensure their disinfection. This method is used principally for large diameter mains where continuous feed is impractical.

9.4 Regardless of the method used, it is necessary to make certain that backflow of the strong chlorine solution into the supplying line does not occur. Following the prescribed contact period, the chlorinated water should be flushed to waste until the remaining water has a chlorine residual approximating that throughout the rest of the system. Bacteriological tests as prescribed by the authorities should be taken, and if the results fail to meet minimum standards, the disinfecting procedure must be repeated and the results again tested before placing the main in service.

10 REMOVAL, RESTORATION AND MAINTENANCE OF PAVED FOOTPATHS, ETC, AFTER LAYING OF PIPE

10.1 Allowable Removal of Pavement

Pavement and road surfaces may be removed as a part of the trench excavation, and the amount removed shall depend upon the width of trench specified for the installation of the pipe and the width and length of the pavement area required to be removed for the installation of gate valves, specials, manholes or other structures. The width of pavement removed along the normal trench for the installation of the pipe shall not exceed the width of the trench specified by more than 150 mm on each side of the trench. The width and the lengths of the area of pavement removed from the installation of gate valves, specials, manholes or other structures shall not exceed the maximum linear dimensions of such structures by more than 150 mm on each side. Wherever, in the opinion of the Authority, existing conditions make it necessary or advisable to remove additional pavement, it shall be removed as directed by the Authority.

10.2 Restoration of Damaged Surfaces and Property

Where any pavement, trees, shrubbery, fences, poles or other property and surface structures have been damaged, removed or disturbed during the course of work, such property and surface structures shall be replaced or repaired after completion of work.

10.3 Replacement of Pavement and Structures

All pavements, paved footpaths, curbing, gutters, shrubbery, fences, poles sod or other property and surface structures removed or disturbed as a part of the work shall be restored to a condition equal to that before the work began, furnishing all labour and materials incidental thereto. In restoring the pavement, sound granite blocks, sound brick or asphalt paving blocks may be re-used. No permanent pavement shall be restored unless and until, in the opinion of the Authority, the condition of the back-fill is such as to properly support the pavement.

10.4 Cleaning Up

All surplus materials, and all tools and temporary structures shall be removed from the site as directed by the Authority. All dirt, rubbish and excess earth from the excavation shall be hauled to a dump and the construction site left clean to the satisfaction of the Authority.

ANNEX A

(*Clause* 2)

LIST OF REFERRED INDIAN STANDARDS

IS No.	*Title*
456 : 1978	Code of practice for plain and reinforced concrete (*third revision*), Amendment 1, Reaffirmed 1991
638 : 1979	Specification for sheet rubber jointing and rubber insertion jointing (*second revision*), Reaffirmed 1987
782 : 1978	Specification for caulking lead (*third revision*), Reaffirmed 1992
1200 (Part 1) : 1992	Method of measurement of building and civil engineering works: Part 1 Earthwork (*fourth revision*)
1536 : 1989	Specification for centrifugally cast (spun) iron pressure pipes for water, gas and sewage (*third revision*), Amendment 1
1537 : 1976	Specification for vertically cast iron pressure pipes for water, gas and sewage (*first revision*), Amendments 4, Reaffirmed 1991
1538 (Part 1) : 1976	Specification for cast iron fittings for pressure pipes for water, gas and sewage: Part 1 General requirements, Amendments 3, Reaffirmed 1991
2405 (Part 2) : 1980	Specification for industrial sieves: Part 2 Perforated plates (*first revision*), Amendment 1, Reaffirmed 1992
5330 : 1984	Criteria for design of anchor blocks for penstocks with expansion joints (*first revision*), Reaffirmed 1990

ANNEX B

(*Foreword*)

COMMITTEE COMPOSITION

Water Supply and Sanitation Sectional Committee, CED 24

Chairman	*Representing*
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Members	
ADVISER (PHE)	Central Public Health & Environmental Engineering Organization, Ministrry of Urban Development, New Delhi
DEPUTY ADVISER (PHE) (*Alternate*)	
SHRI M. S. ASNANI	Public Works Department (Delhi Administration)
SURVEYOR OF WORKS (*Alternate*)	
SHRI AVADHESH KUMAR	Tata Consulting Engineers, Bombay
DR S. GAONKAR (*Alternate*)	
SHRI I. S. BAWEJA	Public Health Engineering Department, Madhya Pradesh
SHRI J. N. CHOBE (*Alternate*)	
SHRI J. D. CRUZ	In personal capacity (*B/58A Gangotri Enclave, Alaknanda, New Delhi*)
SHRI S. G. DEOLALIKER	In personal capacity (*Flat No. 403, Savitri Cinema Commercial Complex, New Delhi*)
SHRI DEVENDER SINGH	In personal capacity (*Annex Building, 2nd Floor, DD-1 , Kalkaji Extension, New Delhi*)
SHRI H. G. GARG	Haryana Public Works Department, Chandigarh
SHRI S. S. BOLA (*Alternate*)	
SHRI V. K. GUPTA	U.P. Jal Nigam, Lucknow
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CHIEF ENGINEER (SEWERAGE PROJECTS) (*Alternate*)	
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SURVEYOR OF WORKS (DCC)IV (*Alternate*)	
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This Indian Standard has been developed from Doc: No. CED 24 (5323)

Amendments Issued Since Publication

Amend No.	Date of Issue	Text Affected

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Printed by Reprography Unit, BIS, New Delhi